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Diffuse tensor cardiac MRI evaluation of fiber architecture of athlete hypertrophic heart in vivo

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Background

The fiber architecture adaption in physiological hypertrophy of the althete heart is still delusive. We aimed to use diffusion tensor cardiac MR (DT-CMR) to evaluate the tissue property and fiber architecture of elite athlete heart.

Methods

Eight elite athletes of Marathon runner (endurance-training type), 8 of weight-lifter (strength-training type) and 8 ordinary style (medical interns) were enrolled. Each subject received a CMR study on a 1.5 T scanner including 1. cine SSPF of a stack of LV short axis for LV mass and function; 2 DT-CMR, ECG-gated stimulated echo diffuse EPI on three levels of LV. Diffuse tensor composed of 6 directions and b value = 300 mm2/sec. 3. phase-contrast flow measurement at ascending aorta for stroke volume. The data were compared between groups and correlated between the parameters.

Results

The myocardium showed no difference of mean diffusivity (MD) and fractional anisotropy between the groups. Weight lifter showed increase of stroke volume / BSA and LV mass / BSA as compared to runner and ordinary groups. The fiber architecture showed an increased proportion of right-handed helical fibers (mainly in the subendocardial zone) in runner and lifter equally, as compared to ordinary group. Putting all 24 subjects together, there was a linear regression between the proportion of right-handed helical fiber and LV mass (R square = 0.38, p = 0.002).

Conclusions

DT-CMR revealed the physiological hypertrophy of athlete heart was mainly due to right-handed helical fibers. This underscores the important role of subendocardial fiber on the LV function.

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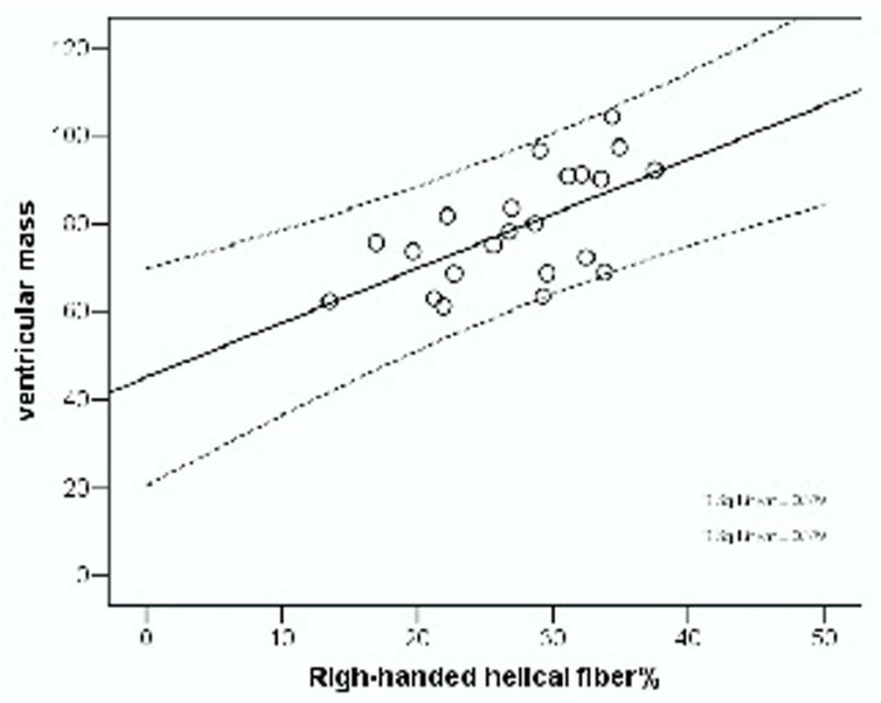

Figure 1 Regression between LV mass and right-handed helical fiber percentage across the 24 subjects.